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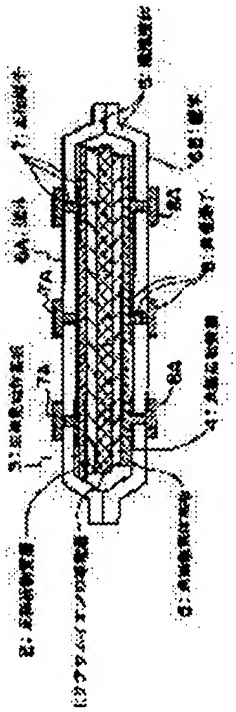
(54) LITHIUM SECONDARY BATTERY AND BATTERY MODULE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve efficiency of current collecting of a lithium secondary battery and make the lithium secondary battery maltiply functional.

SOLUTION: This battery is structured comprising a conductive layer 1 of lithium ion, a negative electrode, a positive electrode and a battery casing 6. The negative electrode comprises a negative electrode active material layer 4, which can store and eject lithium placed contacting with the conductive layer 1, and a negative electrode collector substrate 5 holding the negative electrode active material layer 4. The positive electrode comprises a positive electrode active material layer 2, which can store and eject lithium placed contacting with a side of the conductive layer 1 opposite to a side contacting the negative electrode active material layer 4, and a positive electrode collector substrate 3 holding the positive electrode active material layer 2. The battery casing 6 accommodates the conductive layer 1 of lithium ion, the positive electrode and the negative electrode. A positive terminal 7 and a negative terminal 8 having a plurality of points are provided on an outer surface of the battery casing 6. The positive terminal 7 and the negative terminal 8 are connected to the positive electrode collector substrate 3 and the negative electrode collector substrate 5, respectively, via a conductor filled in via holes formed in the battery casing 6. An electric circuit connected to the positive terminal 7 or the negative terminal 8 is provided on the outer surface of the battery casing 6.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The negative electrode which consists of a charge collector holding the negative-electrode active material layer which can occlusion emit the lithium arranged in contact with the electrolytic solution and this electrolytic solution, and this negative-electrode active material layer, In the lithium rechargeable battery which comes to contain the sheathing object which holds the positive electrode which consists of a charge collector holding the positive-active-material layer which can occlusion emit the lithium arranged in contact with said electrolytic solution, and this positive-active-material layer, said electrolytic solution and positive electrode, and a negative electrode The lithium rechargeable battery characterized by having the terminal of the positive electrode of a multipoint by which said sheathing object was connected with the charge collector of said positive electrode or a negative electrode on the front face, and the negative electrode.
[Claim 2] The lithium rechargeable battery according to claim 1 which said sheathing object was connected with the electrode terminal of the multipoint prepared in the front face, or is characterized by having the connectable electrical circuit.
[Claim 3] The lithium rechargeable battery according to claim 1 or 2 to which said sheathing object is characterized by having the function as a laminated circuit board which carried out the interior of the electrical circuit.
[Claim 4] The conductive layer of the plate-like lithium ion which acts as the electrolytic solution, and the plate-like positive-active-material layer arranged in contact with one field of this conductive layer, The plate-like positive-electrode charge collector arranged in contact with the field which touches said conductive layer of this positive-active-material layer, and the field of the opposite side, The plate-like negative-electrode active material layer arranged in contact with the field of another side of said conductive layer, It is constituted including the plate-like negative-electrode charge collector arranged in contact with the field which touches said conductive layer of this negative-electrode active material layer, and the field of the opposite side, and the sheathing object which forms the container which holds these. Said sheathing object The beer hall formed in said positive-electrode charge collector and the wall which counters, and the conductor with which this beer hall was filled up, The land which is connected with this conductor, is located in the outside surface of this wall, and serves as an electrical circuit node, since -- with the beer hall formed in the terminal of the becoming positive electrode, and said negative-electrode charge collector and the wall which counters The conductor with which this beer hall was filled up, and the land which is connected with this conductor, is located in the outside surface of this wall, and serves as an electrical circuit node, since -- the lithium rechargeable battery according to claim 1 characterized by having had the terminal of the becoming negative electrode and the inside edge of the terminal of said negative electrode being in contact with the negative-electrode charge collector with which said wall counters at the positive-electrode charge collector with which, as for the inside edge of the terminal of said positive electrode, said wall counters, respectively.
[Claim 5] The lithium rechargeable battery according to claim 4 characterized by forming two or more lands of the negative electrode in the wall outside surface of the sheathing object with which the terminal of a positive electrode is prepared, and forming the circuit which connects two or more lands of this negative electrode, the land of said negative electrode of the wall outside surface of the sheathing object with which the terminal of the negative electrode is prepared, or a negative electrode charge collector.
[Claim 6] The lithium rechargeable battery according to claim 4 characterized by forming two or more lands of a positive electrode in the wall outside surface of the sheathing object with which the terminal of the negative

electrode is prepared, and forming the circuit which connects two or more lands of this positive electrode, the land of said positive electrode of the wall outside surface of the sheathing object with which the terminal of a positive electrode is prepared, or a positive electrode charge collector.

[Claim 7] The lithium rechargeable battery according to claim 2 or 3 characterized by having at least one mounting component among an integrated circuit, a semi-conductor, a capacitor, and resistance at the electrical circuit section of a sheathing object.

[Claim 8] A lithium rechargeable battery given in either of claims 2, 3, and 7 characterized by equipping the electrical circuit section of a sheathing object with overcharge, the overvoltage, and the security circuit that can control at least one abnormality among overcurrents.

[Claim 9] The battery module which said lithium rechargeable battery is a lithium rechargeable battery according to claim 1 to 8, and is characterized by a module case coming to contain these lithiums rechargeable battery at a cassette type in the battery module which comes to combine two or more lithium rechargeable batteries.

[Claim 10] The battery module according to claim 9 to which the opening inside a module case is characterized by filling up with inert gas, the noncombustible liquid, the noncombustible inorganic substance, the fire extinguisher, or the flame retarder.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the improvement in a cell load characteristic, and multi-functionalization of a lithium rechargeable battery with respect to a lithium rechargeable battery and a battery module.
[0002]
[Description of the Prior Art] A lithium rechargeable battery has a high voltage and a high energy consistency, and is excellent in the charge-and-discharge property of the storage engine performance or a repeat, and is widely used for the portable public welfare electrical-and-electric-equipment product. Moreover, this cell is enlarged and research and development for utilizing as the object for electric vehicles or Nighttime stationary-energy-storage equipment for home use for power-requirements equalization are performed briskly.
[0003] Until now, the structure of these cells was contained by containers, such as a metal or a can of plastics, or the saccate container, and the terminal of the pair of a positive electrode and a negative electrode was [only providing in one place of these containers, and].
[0004]
[Problem(s) to be Solved by the Invention] However, if cell capacity is raised with such structure and size of an electrode is enlarged utterly, a charge collector will become large, and if it is going to take out a current from one cell terminal, electric resistance will increase, and there is a problem that the load characteristic of a cell falls. The lithium rechargeable battery had preservation stability and a good cycle life in repeat charge and discharge compared with the conventional nickel hydoride battery, the nickel-ccadomium battery, and the lead cell, and it became unnecessary moreover, to exchange cells frequently. That is, since this cell has the endurance as electronic parts, if a cell and electronic parts are unified, lightweight-izing of much more total system and thin shape-ization can be embodied.
[0005] Even if it takes out a mass current, a load characteristic does not fall, but the technical problem of this invention is to obtain a cell and the lithium rechargeable battery which can unify electronic parts.
[0006]
[Means for Solving the Problem] These technical problems discovered that an electrode terminal took out and it could realize with the device of the direction, and resulted in this invention. Namely, in order to take out as many currents as possible from an electrode charge collector Distribute two or more electrode terminals to the outside surface of a cell case, and the beer hall which opens the inside-and-outside side of a cell case for free passage to the cell case of this electrode terminal location is formed. It can attain by arranging the conductor which connects electrically said electrode terminal arranged at the field [of the side which is not in contact with the electrode active material layer of a charge collector], and outside-surface side of a cell case through said beer hall which was able to be opened in the cell case. In this case, as for each charge collector of a positive electrode and a negative electrode, it is desirable to arrange so that the superficial whole breadth of an electrode active material layer may be covered and an electrode active material layer may be touched.
[0007] Furthermore, if the beer hall which connects the front flesh side of a cell case is formed in the part which does not touch the cell structure of a cell case, the both-ends child of a forward negative electrode can form in the whole surface or both sides on the front face of a case, and an electrical circuit can be formed at any cost with the conventional surface mount technology. If it is made this appearance, a ** student is possible for the product of the new concept which a lithium rechargeable battery and the circuit board united.

[0008]
[Embodiment of the Invention] The gestalt of operation of this invention is explained below. Drawing 1 is the sectional view of the lithium rechargeable battery which is the example of this invention. The plate-like positive-active-material layer 2 by which the cell of illustration has been arranged in contact with one field (drawing 1 top face) of the conductive layer 1 of a plate-like lithium ion, and the conductive layer 1 of this lithium ion, The plate-like positive-electrode charge collector substrate 3 arranged in contact with the top face of the positive-active-material layer 2, The plate-like negative-electrode active material layer 4 arranged in contact with the field (drawing 1 inferior surface of tongue) of another side of the conductive layer 1 of said lithium ion, The plate-like negative-electrode charge collector substrate 5 arranged in contact with the inferior surface of tongue of the negative-electrode active material layer 4, The box-like sheathing object (henceforth a cell case) 6 which held these, and two or more beer halls formed in wall 6A which counters said positive-electrode charge collector substrate 3 of the cell case 6 (through hole), Two or more positive-electrode terminals which come to have land 7A which connected with the other end of this interstitial segment the end of the interstitial segment with which the beer hall of said wall 6A was filled up in contact with said positive-electrode charge collector substrate 3, and has been arranged on wall 6A external surface, Two or more beer halls formed in wall 6B which counters said negative-electrode charge collector substrate 5 (through hole), It is constituted including two or more negative-electrode terminals which come to have land 8A which connected with the other end of this interstitial segment the end of the interstitial segment with which the beer hall of said wall 6B was filled up in contact with said negative-electrode charge collector substrate 5, and has been arranged on wall 6B external surface.
[0009] First, the increment in the number of electrode terminals is realizable if it considers as the cell of the configuration shown in drawing 1 . Here, the liquefied electrolytic solution, gel, or a solid electrolyte can be used for the conductive layer 1 of a lithium ion. However, in the case of the liquefied electrolytic solution, the conductive layer 1 of a lithium ion consists of the electrolytic solution and a separator. Under the present circumstances, if a case is an insulating material, the quality of the material will not be asked. For example, the seal nature of a cell can be given and the ingredient used for flexible substrates, such as polyimide resin and PET, can be used.
[0010] Hereafter, the 1st example of this invention is explained. In the example 1, graphite was used for the negative-electrode active material, polyvinylidene fluoride (Following PVDF and brief sketch) was used for the binder, the paste which dissolved graphite and PVDF in N-methyl pyrrolidone (Following NMP and brief sketch) was applied to the copper-foil face of an one side PET film substrate with a thickness [of copper foil] of 20 micrometers, heating / pressurization molding was carried out and the negative-electrode electrode was obtained. Copper foil constitutes said negative-electrode charge collector substrate 5. The thickness of the negative-electrode active material layer after pressing was about 50 micrometers. Moreover, the cobalt acid lithium was used for positive active material, PVDF was used for the binder, using amorphous carbon as an electric conduction assistant, the paste which dissolved a cobalt acid lithium, PVDF, and amorphous carbon in NMP was applied to the aluminum foil side of an one side PET film with a thickness [of aluminum foil] of 20 micrometers, heating / pressurization molding was carried out and the positive-electrode electrode was obtained. Aluminum foil constitutes said positive-electrode charge collector substrate 3. The thickness of the positive-active-material layer after pressing was about 100 micrometers. Moreover, the electrolytic solution which dissolved l. one mol /and obtained the 6 fluoridation phosphoric acid lithium in the solution which mixed ethylene carbonate 30 capacity % and dimethyl carbonate 70 capacity % was enough infiltrated into the separator (TONEN TAPYRUS) with a thickness of 40 microns. This constitutes the conductive layer 1 of said lithium ion. In addition, magnitude of these electrodes (charge collector substrate) was made into width of face of 5cm, and die length of 10cm, and the separator was made into width of face of 6cm, and die length of 12cm.
[0011] in addition, on said one side PET film used as the cell case 6 A beer hole with a diameter of 0.5mm is beforehand formed in 2cm regular intervals by laser processing. After forming uniform beer (conductor of the copper with which said beer hole was filled up) by non-electric-field coppering, The uniform land (electrode sections 7A and 8A formed on the outside surface of the cell case 6 of drawing 1) with a diameter of 0.7mm was given by non-electric-field coppering, and the multipoint connection used as two or more positive-electrode terminals 7 and the negative-electrode terminal 8 was formed. Then, said copper foil or aluminum foil used as a charge collector was pasted up, and spreading of said paste was presented as the object for negative electrodes,

or an one side PET film substrate for positive electrodes.

[0012] Next, with the electrode of the positive/negative produced above, the PET film [in which the multipoint connection was formed] side was carried out outside, said separator was inserted, thermal melting decompression arrival of the perimeter was carried out, and the cell of an example 1 was produced. The initial discharge capacity of this cell was 150mAh(s) with the 0.5mA current, and average discharge voltage was 3.6V. Furthermore, the load characteristic showed 1.5mA or at least 3mA of discharge capacity of 150mAh(s), and it was confirmed that a load characteristic is good. This is the effectiveness which made magnitude of a charge collector the same as the magnitude of a positive-active-material layer or a negative-electrode active material layer, prepared two or more terminals of an electrode, was made to reduce the internal resistance of a cell, and was acquired.

[0013] Although the paste containing a negative-electrode active material or positive active material was applied to the copper-foil face or aluminum foil side of the one side PET film which copper foil or aluminum foil pasted up on one side in the above-mentioned example The PET film used as a cell case, and the copper foil or the aluminum foil which holds a negative-electrode active material layer or a positive-active-material layer, and serves as a charge collector is used as another object. The paste which contains said negative-electrode active material or positive active material in copper foil or aluminum foil is applied, and heating / pressurization molding is carried out and you may make it form a negative-electrode electrode and a positive-electrode electrode, respectively. The same processing as the case of said example is performed on a PET film, and the multipoint connection is beforehand formed in it. In this case, with the electrode of the produced positive/negative, copper foil or aluminum foil is carried out outside, said separator is inserted, after putting that outside with the PET film in which the multipoint connection was formed, further, thermal melting decompression arrival of the perimeter is carried out, and the cell of an example 1 is produced.

[0014] Although a positive-electrode terminal separates on the top face of a cell, a negative-electrode terminal separates on the inferior surface of tongue of a cell, respectively and it is arranged by the cell of drawing 1 , if the two poles of positive/negative are formed in the one side of a cell, a circuit can be formed in this front face like the 2nd example shown in drawing 2 . In drawing 2 , two or more land 8A of a negative electrode is formed in the wall 6A outside surface of the cell case 6 top, and wiring 9 is formed as an electrical circuit which connects land 8A of the negative electrode 8 pulled out by wall 6B of the cell case 6 bottom, and the negative electrode formed in wall 6A of said top. On the contrary, land 7A of two or more positive electrodes is formed in the wall 6B outside surface of the cell case 6 bottom, and you may make it form wiring 10 as an electrical circuit which connects the terminal 7 of the positive electrode pulled out by wall 6A of the cell case 6 top to land 7A of two or more of said positive electrodes formed in wall 6B of the cell case 6 bottom. The beer hall for taking about a positive electrode from the edge bottom of the cell case 6 to the down side, and taking about a negative electrode from the edge subordinate side of the cell case 6 to the up side, respectively is included in wiring 9 and wiring 10. Furthermore, the both-ends child of a positive electrode and a negative electrode can also be prepared in the outside surface of the both sides of Walls 6A and 6B by forming land 7A of two or more positive electrodes in the wall 6B outside surface of the cell case 6 bottom for land 8A of a negative electrode, respectively, and forming wiring 9 and wiring 10 in the wall 6A outside surface of the cell case 6 top.

[0015] Furthermore, if packaging density tends to be raised and it is going to improve a function, laminating formation of the circuit boards 6C and 6D can also be carried out through the adhesives layer 11 on the external surface of the cell case 6 equipped with the electrical circuit at a configuration like the 3rd example shown in drawing 3 . An electrical circuit can consist of this configuration easily in the field of both upper and lower sides of a cell. The ingredient with which the circuit boards 6C and 6D are also conventionally used for the thin film multilayer-interconnection substrate can be used as it is.

[0016] Furthermore, if the laminating of the cell of the configuration of drawing 1 is carried out to the configuration of the 4th example shown in drawing 4 and it is used for it, the series connection of a cell can be attained easily.

[0017] Moreover, if the laminating of the cell of the configuration of drawing 3 which has a forward negative electrode in the 1st page is carried out to the configuration of the 5th example shown in drawing 5 and it is used for it, the cell of a parallel connection mold can be formed easily.

[0018] Moreover, electronic parts can be easily carried in the cell of the configuration of drawing 2 , and the lithium rechargeable battery which carried the electronic parts 12 and 13, such as an integrated circuit, can be

formed like the 6th example shown in drawing 6 . If this electronic circuitry is used, it is also possible to carry the security circuit of avoiding overcharge, an overvoltage, and an overcurrent in the cell itself directly. In drawing 6 , the signal line 14 which transmits the output from electronic parts 12 and 13 is formed.
[0019] Moreover, a battery module can be easily formed by arranging and containing to the cassette whose configuration suited like the 7th example which shows the cell of drawing 1 to drawing 7 . The positive-electrode terminal 15 and the negative-electrode terminal 16 are formed in the module case 17, and the battery module by which parallel connection was carried out can be formed in it only by inserting a cell in the cassette case 17. Although this example has shown parallel connection, if wiring of the cassette case 17 is changed into making it a serial, it will be changed easily. Furthermore, in order to secure cell safety, the inside of this module kale 17 can be filled up with inert gas, a noncombustible liquid, a noncombustible inorganic substance, a fire extinguisher, or a flame retarder.
[0020]
[Effect of the Invention] A load characteristic can be improved, if a multipoint connection is formed in cell case external surface as stated above. Moreover, if this cell structure is used, a circuit can be formed in a lithium rechargeable battery and it will become possible to act as the ** student of the product of the new concept which united a cell and the circuit board.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the 1st example of this invention.
[Drawing 2] It is the perspective view showing the 2nd example of this invention.
[Drawing 3] It is the sectional view showing the 3rd example of this invention.
[Drawing 4] It is the sectional view showing the 4th example of this invention.
[Drawing 5] It is the sectional view showing the 5th example of this invention.
[Drawing 6] It is the perspective view showing the 6th example of this invention.
[Drawing 6] It is the sectional view showing the 7th example of this invention.
[Description of Notations]
1 Lithium Ion Conductive Layer (Electrolytic Solution, Separator, Gel Electrolyte, or Solid-state Polyelectrolyte)
2 Positive-Active-Material Layer
3 Positive-Electrode Charge Collector Substrate
4 Negative-Electrode Active Material Layer
5 Negative-Electrode Charge Collector Substrate
6 Cell Case
6A, 6B Wall
7 Connection Beer Hall and Positive-Electrode Terminal
7A The land of a positive-electrode terminal
8 Connection Beer Hall and Negative-Electrode Terminal
8A The land of a negative-electrode terminal
9 Penetration Beer Hall Negative-Electrode Leading-about Wiring
10 Penetration Beer Hall Positive-Electrode Leading-about Wiring
11 Adhesives Layer
12 13 Electronic parts
14 Signal Wiring
15 Module Positive-Electrode Terminal
16 Module Negative-Electrode Terminal
17 Module Case

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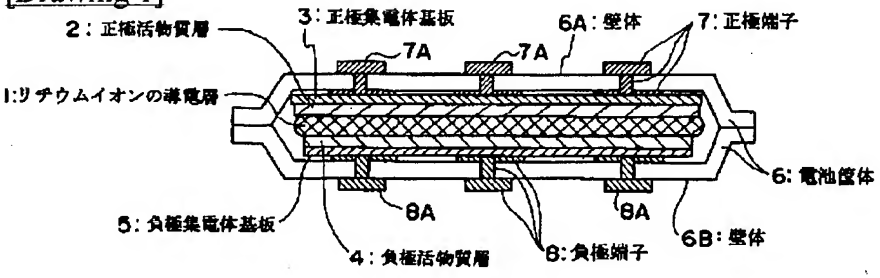
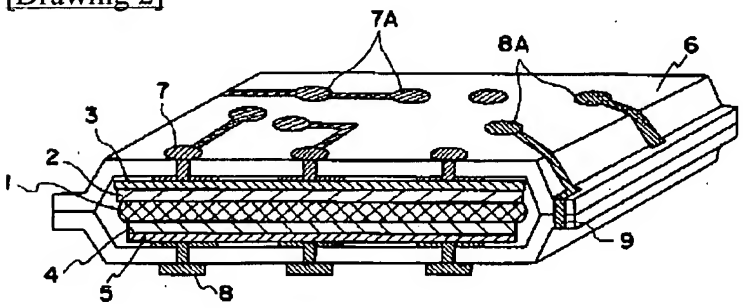
DRAWINGS

[Drawing 1]



[Drawing 2]



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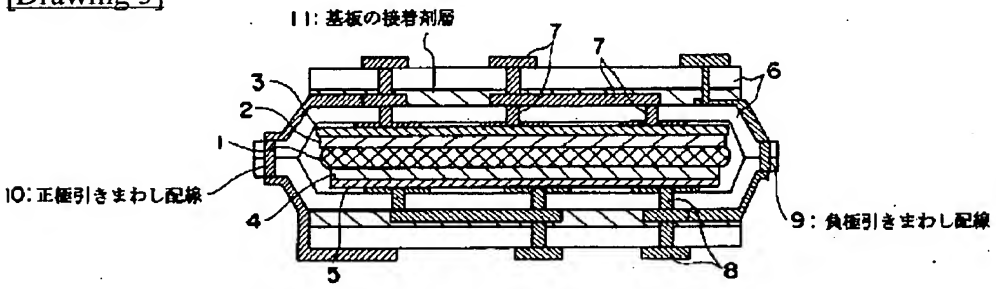

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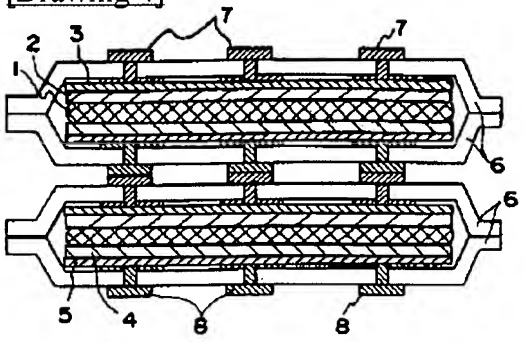
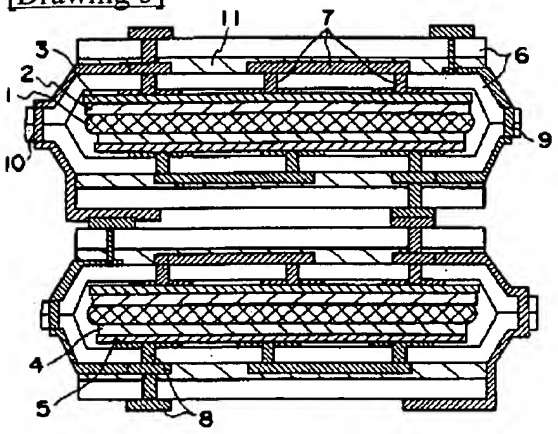
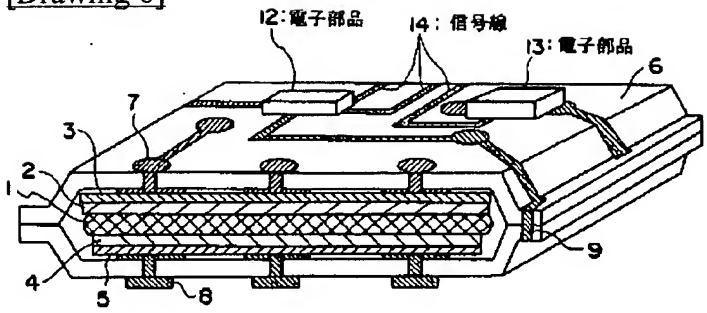


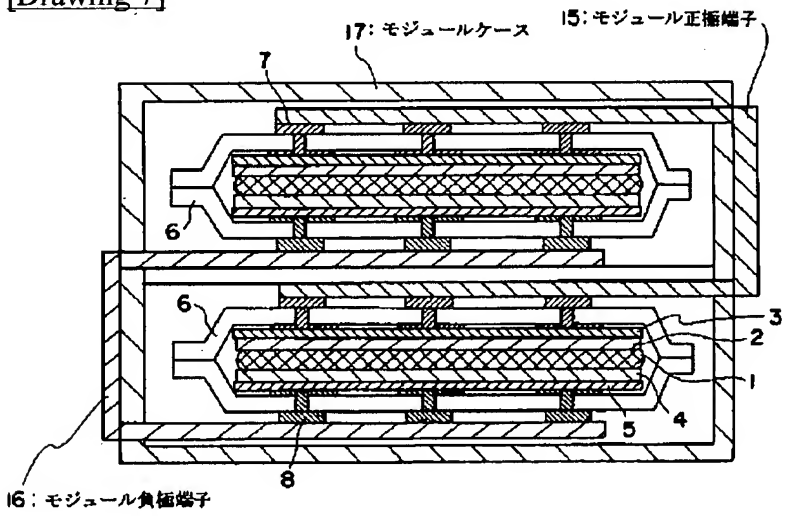
[Drawing 5]



[Drawing 6]



[Drawing 7]



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